means for adding a flow of an inert gas to the selected deposition gases at a flow rate previously determined to achieve a desired low deposition rate from a reaction of the selected deposition gases, said desired low deposition rate being lower than a deposition rate using said selected deposition gases at said deposition gas flow rates with a lower flow rate of said inert gas; and

means for depositing a thin film on the substrate at said low deposition rate from said reaction of said deposition gases to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the thin film.

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REMARKS

Claims 1-6, 9, 10, and 44-62 are pending. Claims 7 and 8 have been canceled without prejudice. Claims 1, 44, 49, 53, 54, 55, 57, and 62 have been amended. No new matter has been introduced. Applicants believe the claims comply with 35 U.S.C. § 112.

Claims 1-7, 9, 10, 44-50, 53, 54, and 57 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Felts et al. (USP 4,888,199) in view of Batey et al. Claim 51 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Felts et al. and Batey et al. in view of Felts et al. (USP 5,364,665). Claims 52, 58, and 59 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Felts et al. in view of Batey et al. and Collins et al. (USP 5,300,460). Claims 8, 60, and 61 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Batey et al. in view of Lee (USP 5,286,581).

Applicants respectfully submit that independent claims 1, 44, 53, and 54 are patentable over the cited references because, for instance, they do not teach or suggest a computer readable program code for controlling the gas delivery system to operate for a specified time period and for causing a layer to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the layer.

The Examiner cites Lee for allegedly disclosing that a first reflection from an interface between the photoresist layer and the antireflective layer of an exposure light is an odd number, but it is <u>not</u> an odd multiple, greater than one, of the wavelength of light to be used in a subsequent process operation on the layer. Lee merely discloses a 180 degrees shift. Nothing in Lee teaches or suggests a thickness that is an odd multiple, greater than one, of the wavelength.

The specification at page 10, line 14, to page 11, line 14, describes a number of advantages of using thicker antireflective layers by selecting a thickness that is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the layer. For instance, the increased thickness achieves improved film consistency from wafer to wafer; provides better control of the refractive index, absorptive index, and thickness of the film; and renders the film suitable for use as a hard mask during an etching step. These are not disclosed or suggested in Lee.

The Examiner alleges that it would have been obvious to realize that odd multiples of the radians as disclosed in Lee would have the same phase angle. Assuming that were the case, there would be no reason to use odd multiples of greater than one since the same phase angle would be present. There is no suggestion to use such odd multiples of greater than one. It is the inventors, not the cited references, that disclosed the reasons for using the odd multiples of greater than one (e.g., to achieve improved film consistency from wafer to wafer; provide better control of the refractive index, absorptive index, and thickness of the film; and render the film suitable for use as a hard mask during an etching step).

For at least the foregoing reasons, independent claims 1, 44, 53, and 54 and dependent claims 2-6, 9, 10, and 45-52 are patentable.

Applicants respectfully assert that independent claims 55, 57, and 62 are patentable over the cited references because, for instance, they do not teach or suggest means for causing the layer to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the thin film.

As discussed above, it is the inventors, not the cited references, that disclosed the use of odd multiples of greater than one, for instance, to achieve improved film consistency from wafer to wafer; provide better control of the refractive index, absorptive index, and thickness of the film; and render the film suitable for use as a hard mask during an etching step. None of the references provide the motivation to use odd multiples of greater than one.

For at least the foregoing reasons, independent claims 55, 57, and 62 and dependent claims 56, 58 and 59 are patentable.

Applicants respectfully submit that claim 60 is patentable over the cited references because, for instance, they do not teach or suggest means for forming a layer of photoresist on the antireflective layer, the antireflective layer having a thickness and refractive indices such that a first reflection from an interface between the photoresist and the antireflective layer of an exposure light will be an odd number which is at least 3 multiplied by 180° out of phase with a second reflection from an interface between the antireflective layer and the substrate layer of the exposure light. Applicants further submit that claim 61 is patentable over the cited references because, for instance, they do not disclose or suggest means for forming a photoresist pattern by exposing the photoresist layer to an exposure light having a wavelength of 365 nm or less and developing the exposed photoresist layer, wherein a phase shift of an odd multiple of at least 3 multiplied by 180° exists between a first reflection of the exposure light from an interface between the photoresist layer and the antireflective layer and a second reflection of the exposure light from an interface between the antireflective layer and the first layer, the first reflection having almost the same intensity as the second reflection to thereby substantially cancel the first and second reflections.

The Examiner cites Lee for allegedly disclosing that a first reflection from an interface between the photoresist layer and the antireflective layer of an exposure light is an odd number, but it is <u>not</u> at least 3 multiplied by 180° (π in radians) out of phase with a second reflection from an interface between the antireflective layer and the substrate layer of the exposure light. As discussed above, nothing in the references

provides the motivation to use an odd number of at least 3. Accordingly, claims 60 and 61 are patentable.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please cancel claims 7 and 8 without prejudice; and amend claims 1, 44, 49, 53, 54, 55, 57, and 62 as follows.

1. (Amended) A substrate processing system, comprising:

a vacuum chamber;

a substrate supporter, located within the vacuum chamber, for holding a substrate;

a gas manifold for introducing process gases into the chamber;

a gas distribution system, coupled to the gas manifold, for distributing the process gases to the gas manifold from gas sources;

a power supply coupled to the gas manifold;

a vacuum system for controlling pressure within the vacuum chamber;

a controller, including a computer, for controlling the gas distribution system, the power supply and the vacuum system; and

a memory coupled to the controller comprising a computer readable medium having a computer readable program code embodied therein for directing operation of the substrate processing system, the computer readable program code including:

computer readable program code for causing the gas distribution system to introduce a first process gas comprising a mixture of SiH_4 and N_20 into the chamber to deposit a first plasma enhanced CVD layer over the wafer; **[and]**

computer readable program code for causing the gas distribution system to introduce a second process gas comprising He into the chamber to control the deposition rate of the first layer<u>; and</u>

computer readable program code for controlling the gas distribution system to operate for a specified time period and for causing the first plasma enhanced CVD layer to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the layer.

7.-8. CANCELED.

44. (Amended) A substrate processing system, comprising:

a process chamber;

a substrate support, located within the process chamber, for supporting a substrate;

a power supply;

a gas delivery system for delivering process gases into the process chamber;

a controller configured to control the power supply and the gas delivery system; and

a memory coupled to the controller comprising a computer readable medium having a computer readable program embodied therein for directing operation of the substrate processing system, the computer readable program including a first set of computer instructions for controlling the gas delivery system to introduce selected deposition gases into the process chamber at deposited gas flow rates, a second set of computer instructions for controlling the gas delivery system to add a flow of an inert gas to the selected deposition gases at a flow rate previously determined to achieve a desired low deposition rate from a plasma enhanced reaction of the selected deposition gases, the desired low deposition rate being lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas, **[and]** a third set of computer instructions for controlling the power supply to supply power to the process chamber to produce a plasma enhanced reaction of the deposition gases in the process chamber to deposit a film at the low deposition rate, and a fourth set of computer instructions for controlling the gas delivery system to operate for a specified time period and for causing the film to be formed to a thickness which is an odd multiple,

greater than one, of a wavelength of light to be used in a subsequent process operation on the film.

49. (Amended) The substrate processing system of claim 44 further comprising a vacuum system for controlling pressure within the process chamber, and wherein the computer-readable program further comprises a **[fourth]** fifth set of computer instructions for controlling the vacuum system to maintain a chamber pressure in the range of 1-6 Torr, and wherein the selected deposition gases comprise SiH_4 flowed into the chamber at a rate of 5-300 sccm and N_2O flowed into the chamber at a rate of 5-300 sccm.

53. (Amended) A substrate processing system, comprising:

a process chamber;

a substrate support, located within the process chamber, for supporting a substrate;

an RF power supply;

a heater;

a gas delivery system for delivering process gases into the process chamber;

a controller configured to control the power supply and the gas delivery system; and

a memory coupled to the controller comprising a computer readable medium having a computer readable program embodied therein for directing operation of the substrate processing system, the computer readable program including a first set of computer instructions for controlling the gas delivery system to flow He into the process chamber at a selected flow rate to provide a chamber pressure in the range of 1-6 Torr, a second set of computer instructions for controlling the RF power supply to supply power of 50-500 Watts to the process chamber, a third set of computer instructions for controlling the heater to heat the substrate to a temperature in the range of 200-400°C, a fourth set of computer instructions for controlling the gas delivery system to flow SiH_4 at a flow rate of 5-300 sccm into the process chamber, **[and]** a fifth set of computer

instructions to flow N_2O at a flow rate of 5-300 sccm into the process chamber, wherein a ratio of the selected flow rate of He to the combined flow rate of SiH_4 and N_2O is at least 6.25:1 to deposit an antireflective layer on the substrate at a deposition rate which is lower than a deposition rate using the same flow rate of SiH_4 and the same flow rate of N_2O with a lower flow rate of He, and a sixth set of computer instructions for controlling the gas delivery system to operate for a specified time period and for causing the antireflective layer to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the layer.

54. (Amended) A substrate processing system, comprising:

a process chamber;

a substrate support, located within the process chamber, for supporting a substrate;

a power supply;

a gas delivery system for delivering process gases into the process chamber;

a controller configured to control the power supply and the gas delivery system; and

a memory coupled to the controller comprising a computer readable medium having a computer readable program embodied therein for directing operation of the substrate processing system, the computer readable program including a first set of computer instructions for controlling the gas delivery system to flow selected deposition gases into the process chamber at deposition gas flow rates, a second set of computer instructions for controlling the gas delivery system to add a flow of an inert gas to the selected deposition gases at a flow rate previously determined to achieve a desired low deposition rate from a reaction of the selected deposition gases, the desired low deposition rate being lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas, **[and]** a third set of computer instructions for controlling the power supply to supply power to the process chamber to react the deposition gases to deposit a film at the low deposition rate, and a

fourth set of computer instructions for controlling the gas delivery system to operate for a specified time period and for causing the film to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the film.

55. (Amended) A substrate processing system comprising:

a process chamber;

a substrate support, located within the process chamber, for supporting a substrate;

a gas delivery system for delivering selected deposition gases into the process chamber at deposition gas flow rates;

means for adding a flow of an inert gas to the selected deposition gases at a flow rate previously determined to achieve a desired low deposition rate from plasma enhanced reaction of the selected deposition gases, the desired low deposition rate being lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas; and

means for depositing a thin film at the low deposition rate from a plasma enhanced reaction of the deposition gases and for causing the thin film to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the thin film.

57. (Amended) A substrate processing system comprising:

a processing chamber;

a substrate support, located within the processing chamber, for supporting a substrate;

means for flowing He into the processing chamber at a selected flow rate to provide a chamber pressure in the range of 1-6 Torr;

means for connecting the chamber to an RF power supply to receive 50-500 Watts;

means for heating the substrate to a temperature in the range of 200-400°C;

means for flowing SiH_4 through a gas distribution system at a flow rate of 5-300 sccm; and

means for flowing N_2O through the gas distribution system at a flow rate of 5-300 sccm, wherein a ratio of the selected flow rate of He to the combined flow rate of SiH_4 and N_2O is at least 6.25:1 to deposit an antireflective layer on the substrate at a deposition rate which is lower than a deposition rate using the same flow rate of SiH_4 and the same flow rate of N_2O with a lower flow rate of He <u>and to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the antireflective layer</u>.

62. (Amended) A substrate processing system comprising:

a substrate processing chamber;

a substrate support, located within the process chamber, for supporting a substrate;

a gas delivery system for delivering process gases into the substrate processing chamber;

means for flowing selected deposition gases into the substrate processing chamber at deposition gas flow rates;

means for adding a flow of an inert gas to the selected deposition gases at a flow rate previously determined to achieve a desired low deposition rate from a reaction of the selected deposition gases, said desired low deposition rate being lower than a deposition rate using said selected deposition gases at said deposition gas flow rates with a lower flow rate of said inert gas; and

means for depositing a thin film on the substrate at said low deposition rate from said reaction of said deposition gases <u>to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the thin film</u>.